

A Precision-Agriculture Approach to reducing N₂O emissions using the nitrification inhibitor DCD.

A collaboration between the NIWA Agricultural Emissions Group and AgriOptics

Nitrification inhibitors have been recognized as a promising methodology for mitigating agricultural nitrous oxide (N₂O) emissions in New Zealand. Plot scale (<1m²) experiments, with known deposition rates of nitrification have shown that the addition of Eco-N, a commercial suspension-based formulation of Dicyanodiamide (DCD), which inhibits soil nitrification, can reduce nitrous oxide emissions by up to 67%. However, the efficacy of DCD has yet to be demonstrated at a paddock scale (>1 ha) in New Zealand grazing systems. Extrapolating from plot-scale to field scale is complicated by field scale variability that cannot be captured by chamber sampling, uneven deposition of urine patches, and non random behaviour of grazing animals. Micrometeorological approaches are appropriate for measuring N₂O emissions at a paddock scale because they integrate over field-scale variability and measure continuously.

The industry recommendation for application is a blanket application of Eco-N of 10 g/L applied within 7 days of grazing during a period in which the 9AM 10cm soil temperature does not exceed 14 °C. However, since N₂O emission is strongly associated with urine patches, there is an opportunity to reduce the amount of Eco-N by applying the product only on that portion of the paddock that received urine deposition. An adaption of Weed-Seeker Technology pioneered by Craige Mackenzie's company Agri-Optics was used to detect urine patches (based on the different reflectance of urine-affected pasture) and spraying them selectively with Eco-N.

NIWA's Agricultural Emissions group led by Andrew McMillan and Mike Harvey conducted an experiment from May 2010 until June 2010 at Craige MacKenzie's Three Springs Dairy property in Methven, Canterbury to investigate the efficacy of DCD in reducing N₂O emissions. We compared two DCD application methods: (1) an industry-standard blanket application of 10 kg Eco-N/ha, and (2) the AgriOptics selective application methodology, against control plots that received identical grazing and mineral fertilization, but no DCD.

While the results of the N₂O emissions from each treatment are still undergoing analysis, we are able to report the reduction in the use of Eco-N that we achieved using the AgriOptic's selective application method. Andrew McMillan from NIWA operated the Weed-Seeker/AgriOptics equipment to selectively apply the 10 g DCD/ha on urine patches only. The suspension of DCD was 1 kg per 20L of water. In the blanket application of Eco-N the contractor applied 300 L of the suspension was used on a 1.5 ha to achieve a blanket application rate of 10 kg/ha. Using the AgriOptics selective application method of 10 kg/ha to urine patches resulted in the application of only 78 L of the suspension or, averaged over the entire paddock, an application rate 2.6 kg/ha. Compared to the blanket application rate of Eco-N, this is a reduction of 74%, and implied that roughly 26% of the pasture was affected by urine patches.

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